beef+lamb new zealand

FACT SHEET

FEBRUARY 2007

TRACE ELEMENT NUTRITION OF SHEEP

The four important trace elements to consider in New Zealand flocks are selenium (Se), copper (Cu), iodine (I) and cobalt (Co)

Assessing the trace element status of a flock should be part of the animal health programme. A vet will be able to help collect the appropriate tissue samples and interpret the trace element data.

A trace element deficiency will impact on ewe (and ram) fertility, as well as the health and growth of lambs.

Trace element research in New Zealand has provided some of the best data in the world on the diagnosis and prevention of deficiencies.

In some situations a trace element deficiency may be subclinical or marginal and, therefore, can only be detected by collecting the appropriate blood and liver samples for trace element and/or enzyme determinations.

As most trace element deficiencies occur in lambs, prevention is the best approach. For example, to prevent white muscle disease (Se), swayback (Cu) and goitre (I), treat the ewe in early gestation with Se, Cu and I. These are readily transferred across the placenta. Preventing Co deficiency is the exception – lambs are best treated with vitamin B12 at docking.

TRACE ELEMENT – SELENIUM

SELENIUM DEFICIENCY

About 30 per cent of the pastures in New Zealand will not provide an adequate selenium intake for grazing livestock.

Function of selenium

The main role of Se is as an antioxidant to protect the integrity of the cell membranes. It also maintains the integrity of the immune system.

Clinical signs of selenium deficiency

- Infertility in ewes as a result of embryonic mortality which occurs three to four weeks after conception. This results in a higher percent of barren ewes and a low lambing percentage.
- Poorer motility and increased morphological defects in ram sperm.
- White muscle disease in lambs, characterised by a non-inflammatory degeneration or necrosis of the skeletal and cardiac muscles. Lambs are born dead or die suddenly within few days of birth. Some deaths occur three to six weeks after birth (delayed white muscle disease).
- Poor lamb growth rates.

Selenium deficiency diagnosis

Blood or liver selenium concentrations from five to eight samples per flock, and the levels compared to selenium tissue reference ranges which have been determined from selenium supplementation animal performance trials. Ewes should be sampled four to five weeks before mating, and lambs prior to weaning.

Blood selenium concentrations of <130, 130-250 and >250 nmol/l reflect a deficient, marginal adequate selenium status, respectively.

Liver selenium concentrations of <250, 250-450 and >450 nmol/kg fresh tissue reflect a deficient, marginal and adequate Se status, respectively. Some vets use blood glutathione peroxidase activity, and the respective values for deficiency and adequacy are <1.0 and >3.0 Ku/L- 5°C.

Sheep grazing pastures with <0.03 mg/kg DM are at risk of becoming selenium deficient.

PREVENTING SELENIUM DEFICIENCY

Warning: Use only one of the following approaches to prevent selenium deficiency, otherwise selenium toxicity could become a serious problem.

Inject ewes and rams subcutaneously in the neck region with a long-acting product containing barium selenate four weeks before mating. The dose is 50mg Se (1mg Se/kg LW). This will increase the selenium status of the ewe during gestation and lactation; the effect being the selenium status of their lambs will be increased from birth to weaning or time of slaughter. Therefore lambs do not have to be supplemented with selenium, since treating the ewe protects the lamb from white muscle disease and ensures good growth rates until at least weaning. If ewes have not been treated and their lambs are selenium deficient, then they can be treated at three to four weeks of age at docking time. The dose is 12mg Se (1mg Se/kg LW) and its efficacy is for at least 10 months.

Oral dosing of 5mg of selenium (0.1mg Se/kg LW) as sodium selenate to ewes and rams at four weeks before mating, the ewes again at four weeks before lambing, and a further 2mg Se to their lambs at docking. Lambs will require further drenching at six to eight week intervals to maintain selenium status.

Topdress in the autumn with 0.5 or 1kg of selenium prills to provide 10g Se/ha annually. The ewes (and rams) must graze a selenium-treated pasture for a minimum of eight weeks; namely four weeks pre-mating and the following four weeks during mating. Their lambs are likely to need a further 2mg selenium at docking. Preferably, ewes should be grazed on selenium-treated pasture for at least 16 weeks. From a management point of view, after applying the selenium-amended fertiliser, the pastures must not grazed for at least four weeks, to allow the Se to be 'washed' into the soil and taken up by the pasture.

Dose ewes with one 10g Se/Fe (iron) pellet, four weeks before mating.

SELENIUM TREATMENT DECISION TREE

<table>
<tr><th>TIME</th><th>PROCEDURE</th><th>SAMPLING</th></tr>
<tr><td>February</td><td>Sample ewes

Inject ewes and rams
or
Dose ewes Se/Fe (iron) pellet
or
Topdress
or
Oral dose ewes & rams
(first dose)</td><td>Blood test or liver biopsy ewes
<table><tr><th></th><th>LOW</th><th>MARGINAL</th><th>ADEQUATE</th></tr><tr><td>Blood (nmol/l)</td><td><130</td><td>130-250</td><td>>250</td></tr><tr><td>Liver (nmol/kg)</td><td><250</td><td>250-450</td><td>>450</td></tr><tr><td>Glutathione perixdase (Ku/l- 25˚c)</td><td><1.0</td><td></td><td>>3.0</td></tr></table></td></tr>
<tr><td>August (four weeks before lambing)</td><td>Oral dose ewes
(second dose)</td><td></td></tr>
<tr><td>September/October (docking)</td><td>Oral dose ewes (third dose) at docking then every six to eight weeks</td><td></td></tr>
</table>

TRACE ELEMENT – IODINE

IODINE DEFICIENCY

In New Zealand iodine deficiency is usually associated with feeding pregnant ewes on brassica crops. More recently, iodine deficiency has been observed in sheep grazing only on pasture.

Function of iodine

- Constituent of the thyroid hormones
- Thyroid hormones control basal metabolism and heat production, cell differential and the growth of tissues such as brain, central nervous system and lungs
- Important for foetal development

Clinical signs of iodine deficiency

- Enlarged thyroid or goitre in lambs
- Increased perinatal mortality, particularly in cold weather because iodine deficient lambs have less control over body temperature
- Low birth weights and hairless lambs
- Decreased fecundity

Iodine deficiency diagnosis

The presence of goitre in lambs. A thyroid (g) to liveweight (kg) ratio of >0.4 is indicative of iodine deficiency.

Ewe serum iodine concentrations of >50 µg/l, determined in the autumn, are associated with healthy lambs. Serum iodine concentrations of <29 µg/L are associated with a high incidence of goitre in lambs. Serum thyroxine (T4) and tri-iodothyronine (T3) concentrations are not satisfactory indicators of the iodine status of ewes.

Measuring the iodine concentration in a ewe's milk has been suggested as a way of gauging her iodine status, with milk iodine concentration of <80ug/l indicating an iodine deficiency. However, daily fluctuations in milk iodine concentration make a single milk sample insufficient to gauge deficiency. Another limitation of this method of sampling is that the critical period for iodine in the ewe is before lambing and the start of lactation.

Sheep grazing pastures with iodine concentrations of <0.12 mg/kg DM are at risk of becoming iodine deficient. The presence of goitrogens in plants increase dietary iodine requirements. Goitrogens include thiocynates in brassicas and cyanogenetic glucosides in white clover. For this reason it is not possible to recommend a dietary iodine requirement with any confidence.

PREVENTING IODINE DEFICIENCY

Untreated pregnant ewes fed brassicas are at a very high risk of giving birth to lambs with goitre.

Inject ewes intramuscularly, in the anterior neck region, with 1.5 ml iodised oil to provide 390mg iodine four weeks before mating.

Drench ewes with 200mg iodine as potassium iodide or iodate at eight and four weeks before lambing.

IODINE TREATMENT DECISION TREE

<table>
<tr><th>TIME</th><th>PROCEDURE</th><th colspan="3">SAMPLING</th></tr>
<tr><td>Lambing</td><td>Conduct post mortems on 10-20 dead newly born lambs for thyroid removal and weighing</td><td colspan="3">Average Thyroid: Body weight ratio of 10-20 autopsied lambs
Thyroid sample:</td></tr>
<tr><td></td><td></td><td></td><td>LOW</td><td>ADEQUATE</td></tr>
<tr><td></td><td></td><td>Ratio g:kgLW</td><td>>0.4</td><td><0.4</td></tr>
<tr><td>Four weeks before mating</td><td>Inject ewes intramuscularly 1.5ml iodised oil (390mg iodine)
or</td><td colspan="3"></td></tr>
<tr><td>Eight and four weeks before lambing</td><td>Drench ewes twice with 200mg Iodine (potassium iodide or iodate)</td><td colspan="3"></td></tr>
</table>

TRACE ELEMENT – COPPER

COPPER DEFICIENCY

In New Zealand copper deficiency is usually associated with increased pasture molybdenum (Mo) concentrations. The metabolism of copper is complex as the Mo influences copper absorption and liver copper storage, thereby increasing dietary copper requirements. Other trace elements such as iron (Fe) and zinc (Zn) have also been observed to influence copper metabolism. Cattle and deer are more prone to copper deficiency than sheep.

Functions of copper

- Development of the nervous system and maintenance of myelin sheath around nerve fibres
- Bone growth and development
- Maintains the integrity of the immune system
- Role in iron metabolism
- Development of the fleece and skin pigmentation

Clinical signs of copper deficiency

The lamb is the most sensitive to Cu deficiency.

- Nerve disorder termed swayback or enzootic ataxia
- Bone disorder described as osteoporosis
- Poorer growth might occur when pasture Mo >3mg/kg DM

Copper deficiency diagnosis

Biochemical criteria associated with the presence of clinical signs such as swayback.

Liver is the tissue of choice as it reflects body copper stores. Collect five to eight liver samples using a biopsy technique from ewes in the early autumn. Livers can also be collected from the meat processing plants when cull ewes and lambs are slaughtered, but biopsies allow samples to be collected from the groups of interest at the appropriate time. There is a seasonal decline in liver copper concentrations, with the lowest value being observed in late winter/early spring. Sheep with a barely adequate copper status in the autumn may be supplemented with copper.

Serum copper concentrations of <4.5, 4.5-8 and >8 µmol/L reflect a deficient, marginal and adequate copper status, respectively.

Liver copper concentrations <65, 65-100 and >100 µmol/kg fresh tissue reflect a deficient, marginal and adequate copper status, respectively.

Pasture with copper concentrations <4mg Cu/kg DM are associated with a simple copper deficiency, while pastures with 5-6mg Cu/kg DM, in the presence of low Mo (<1 mg/kg DM) are adequate. Increasing Mo to >3 mg/kg DM at pasture copper concentration of 5-6 mg/kg DM will not maintain an adequate copper status in sheep. The pasture analyses must include Mo as well as copper.

COPPER DEFICIENCY PREVENTION

Sheep are very susceptible to copper toxicity. Check dose rates and instructions for each product.

Dose ewes with 5g CuO (Copper oxide) needles (bolus) early in gestation. This will increase the copper status of the ewe, the foetus and her lamb from birth to at least nine to 10 weeks of age. The copper concentration of ewe's milk is not greatly changed.

Inject ewes with copper (0.5-1.0mg/kg LW; 25-50mg Cu) during early to mid- gestation. The copper status of the foetus and lamb will be increased.

Topdress pasture annually with 5kg copper sulphate (1.25kg Cu/ha) in the autumn. From a management point of view, pasture must not be grazed for at least four weeks to allow the copper to be 'washed' into the soil and taken up by the pasture.

Drenching with copper is **not recommended** as it is only effective for a short period of two to three weeks.

COPPER TREATMENT DECISION TREE

This decision tree is to aid management of copper deficiency. It should be used in conjunction with the technical notes on Trace element nutrition of sheep – Copper

TIME	PROCEDURE	SAMPLING			
February/March	Sample ewes	**BLOOD TEST OR LIVER BIOPSY EWES**			
			LOW	**MARGINAL**	**ADEQUATE**
		Blood (nmol/l)	<4.5	4.5-8.0	8.0
		Liver (nmol/kg)	<65	65-100	>100
May	Topdress pasture Treat ewes Dose with bolus *or* inject				

TRACE ELEMENT – COBALT

COBALT DEFICIENCY

About 13% of pastures in New Zealand will not provide an adequate cobalt intake for lambs which are the most sensitive to cobalt deficiency.

Function of cobalt

- Cobalt is essential for the synthesis of vitamin B12 by rumen micro-organisms
- Vitamin B12 is important for energy and protein metabolism
- Maintains the integrity of the immune system

Clinical signs of cobalt deficiency

- Poor growth rates
- Loss of appetite
- Watery eye discharge
- Increased lamb death rates at lambing time

Cobalt deficiency diagnosis

Vitamin B12 concentrations from 10 blood (serum) and five liver samples per group of lambs, and the vitamin B12 tissue reference ranges determined from Co/ vitamin B12 supplementation lamb growth trials.

Serum vitamin B12 concentrations of <250, 250-450 and >450 pmol/L reflect a deficient, marginal and adequate cobalt status, respectively.

Liver vitamin B12 concentrations of <200, 200-375 and >375 nmol/kg fresh tissue reflect a deficient, marginal and adequate cobalt status, respectively.

Sheep grazing pasture with cobalt concentrations <0.08 mg/kg DM will become cobalt deficient. Note that soil contamination can increase "pasture" cobalt concentrations and, therefore, tissue vitamin B12 concentrations give a more reliable assessment of lamb vitamin B12 status.

Cobalt deficiency prevention

Treat with 3mg of microencapsulated vitamin B12 as a long-acting injection given subcutaneously in the neck region once at docking or weaning. Preference should be given to injecting at docking, because lambs should be treated as early as possible. Treating the ewes (12mg vitamin B12) during gestation only gives a limited period of three to four weeks protection to their lambs.

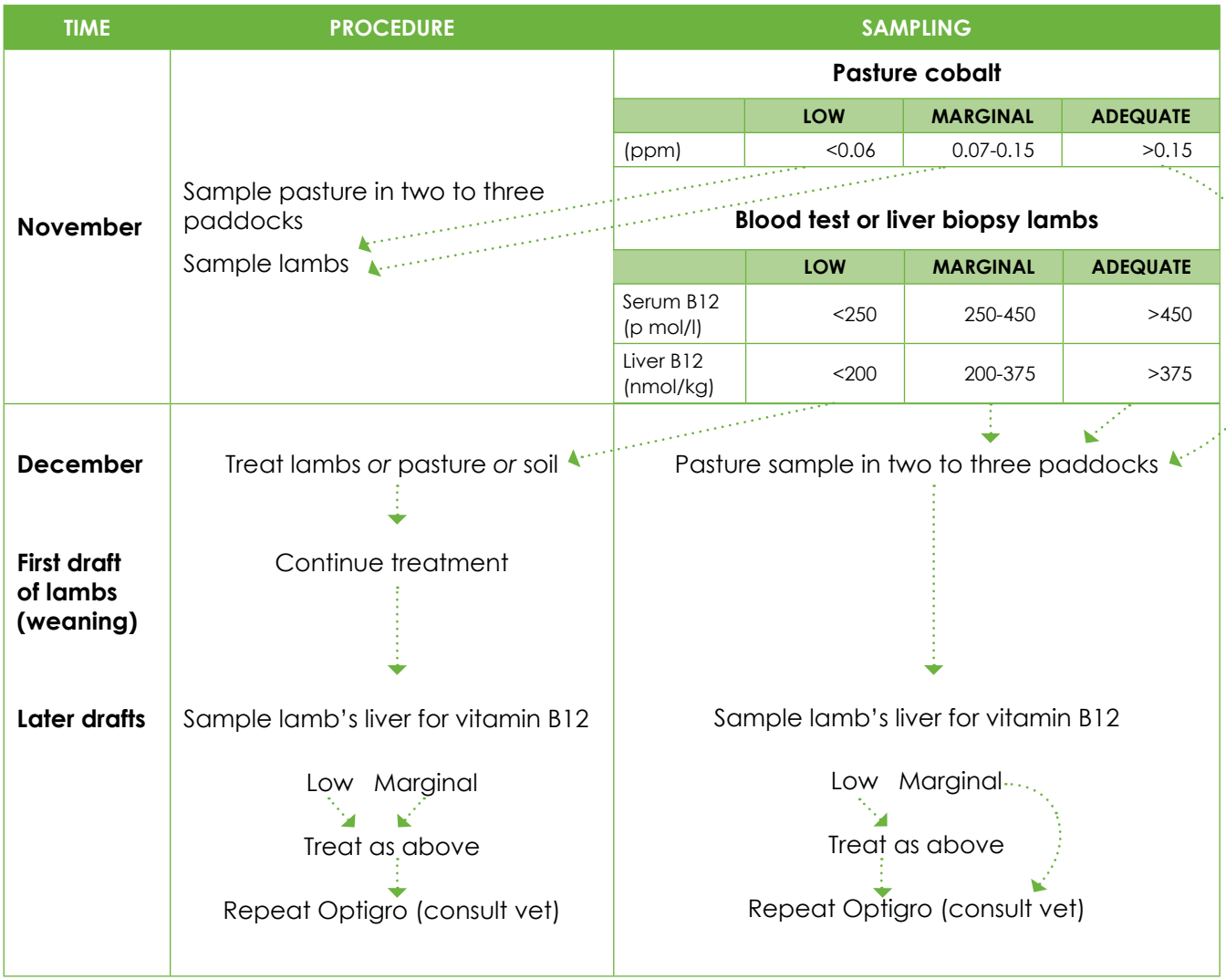
Inject with 2mg of water soluble vitamin B12 subcutaneously every four to six weeks from docking to weaning.

Dose with one 10g cobalt pellet at weaning.

Topdress with 350g/ha cobalt sulphate (70g Co/ha) annually in the spring. This approach is unsatisfactory on some soils because high manganese (Mn) levels can interfere with Co uptake by plants. From a management point of view, pasture must not be grazed for at least four weeks to allow the Co to be 'washed' into the soil and taken up by the pasture.

COBALT TREATMENT DECISION TREE

This decision tree is to aid management of cobalt deficiency. It should be used in conjunction with the technical notes on Trace element nutrition of sheep – Cobalt.



ACKNOWLEDGEMENTS

Further reading: Grace ND, Managing trace element deficiencies, AgResearch, Palmerston North

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Redesigned and reprinted May 2012